MULTIMEDIA UNIVERSITY

STUDENT IDENTIFICATION NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2018/2019

BDE2014 – DIFFERENTIAL EQUATIONS

(All Sections / Groups)

30 MAY 2019
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 3 pages excluding Cover Page.
2. Attempt all 4 questions. The distribution of marks for each question is given.
3. The candidate is allowed to use scientific calculators that are permitted to be used in the examination.
4. Please write your answers in the **Answer Booklet** provided.

Question 1 [Total 25 marks]

a) Solve the following differential equation using the separable equation method:

$$\frac{dy}{dx} = -\frac{x}{y}; \qquad y(4) = -3$$

[6 marks]

b) Show that the following differential equation is exact, and find the general solution:

$$\left[(x+1)e^x - e^y\right]dx - xe^y dy = 0$$

[9 marks]

c) Consider the following differential equation (DE):

$$x\frac{dy}{dx} - 4y = x^6 e^x$$

(i) Rewrite the DE in the form of $\frac{dy}{dx} + p(x)y = r(x)$.

(ii) From (i), find its integrating factor. **[2 marks]**

(iii) Hence, find the general solution of the DE. **[3 marks]**

[5 marks]

Question 2 [Total 25 marks]

a) Solve the initial value problem:

$$y'' - 2y' + y = 0\ ; \qquad y(0) = 1\ ; \qquad y'(0) = 5$$

[7 marks]

b) Consider the following differential equation (DE) using Undetermined Coefficient-Superposition Approach:

$$y'' - 6y' + 9y = 6x^2 + 2 - 12e^{3x}; \qquad y(0) = 0;\ y'(0) = 0$$

(i) Find the complementary function, y_h of the above DE.

(ii) Find the particular function, y_p of the above DE. **[3 marks]**

(iii) Find the general equation, y of the above DE. **[10 marks]**

[5 marks]

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Question 3 [Total 25 marks]

a) Find the general solution for the following non-homogenous Cauchy-Euler equation by using variation of parameters method:

$$x^2y'' - 3xy' + 3y = 2x^4e^x$$

[18 marks]

b) Eliminate arbitrary constants from $z = (x-a)^2 + (y-b)^2$ to form the partial differential equation.

[7 marks]

Question 4 [Total 25 marks]

a) Classify the following partial differential equations as hyperbolic, parabolic, or elliptic. Here $x > 0, y > 0$.

(i) $8\mu_{xx} + 3\mu_{yy} - 2\mu_x = 0$

[3 marks]

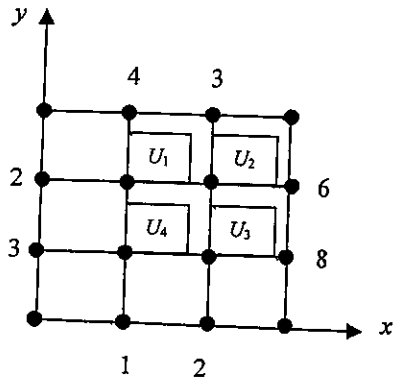
(ii) $\mu_{xx} - \frac{1}{2}\mu_{xy} + 2\mu_{yy} + 3\mu_x = 2$

[3 marks]

(iii) $-2x\mu_{xy} + 5y\mu_{yy} = 3$

[3 marks]

b) Solve $u_{xx} + u_{yy} = F(x,y)$, if $F(x,y) = x^2 + 2y$



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(i) With mesh length, $h=1$ for the square as in figure above, and assume that $(u_2, u_3, u_4) = (0,0,0)$, find the initial values of u.

[7 marks]

(ii) Improve the values in (i) using Gauss-Seidel iteration. Iterate the process up to three iterations. (Use 4 decimal places for all the workings).

[9 marks]

End of paper.